North West Water

Directorate of Planning

R. IRK

INTENSIVE SURVEY

15th April 1986

WATER QUALITY PLANNING (EAST)

Report No.WQE 87/3

R IRK INTENSIVE SURVEY - 15 APRIL 1986

CONTENTS

TABLES 1-6
GRAPHS 1-5
APPENDICES 1-3
MAP A

0110J

R IRK INTENSIVE SURVEY - 15 APRIL 1986

1. INTRODUCTION

The R Irk is one of the most polluted rivers in North West Water's area. In dry weather the bulk of the flow in the river (approx 90 Mld^{-1} as measured at Scotland Weir just upstream of the R Irwell confluence) originates from the 3 sewage works within the catchment. These are:-

(i) Castleton ETW (DWF = 1.4 Mld^{-1}) - a filter works which discharges to Trub Brook, a tributary of Whit Beck.

(ii) Royton ETW (DWF = 7.0 Mld^{-1}) - an activated sludge plant with filters which discharges into Luzley Brook just upstream of the R Irk.

(iii) Oldham ETW (DWF = 72 Mld^{-1}) - an activated sludge plant with filters which discharges into Wince Brook. The flow in Wince Brook upstream of Oldham ETW is small (5% ile < 1 Mld^{-1}) and hence in dry weather, the water quality of Wince Brook reflects the effluent quality produced by this works.

The R Irk is badly affected by numerous unsatisfactory storm sewage overflows (SSOs) within the catchment. Several sewerage projects have been carried out in recent years within the Irk catchment especially in the Middleton area, where earlier major redevelopment of the old town centre took place between 1969 and 1976, at which time the main sewers were reconstructed. Appendix 1 lists some of the projects completed in the past few years in the Rochdale MBC and Oldham MBC areas.

Whilst the resewerage work carried out to date has resulted in the abandonment of numerous unsatisfactory SSOs on the R Irk and its tributaries, many more remain, particularly in the lower reaches. In the March 1986 SIP list, there were 4 designated SIPs in the Irk catchment as follows:-

Wince Brook	(No 4, 3rd equal, 71 points)
	3.7km between Foxdenton Lane and the R Irk
Moston Brook	(No 10, 6th equal, 70 points)
	6.9km between Hollinwood and the R Irk
Luzley Brook	(No 16, 15th equal, 65 points)
	3.5km between Shaw and the R Irk
R Irk nr Royton	(No 19, 19th equal, 62 points)
	3.5km between Dogford Road and Street Bridge

It is likely that a significant part, if not all, of the 11.6 km reach of the R Irk between Wince Brook and the R Irwell will be redesignated a SIP in the near future. (In 1985 the 16.5 km reach between Luzley Brook and the R Irwell had been designated an SIP). However the SIP on Luzley Brook may soon disappear following the completion of the Royton Southern Stage 3 project.

Whilst the present condition of the R Irk is very bad it should be noted that conditions were even worse prior to the completion of numerous sewerage projects within the catchment. Thus the SIP on the R Irk between Royton and Middleton has been removed, and Wince Brook has improved from being a nuisance to a SIP.

The net effect of the lack of dilution in dry weather for the sewage effluent discharges and discharges due to blocked sewers, and the problems caused by unsatisfactory SSO's within the catchment in wet weather, is that, apart from a short length at the top of the R Irk, the R Irk fails to meet its LTO of class 2, with 11.9 km in class 3 and the bottom 6.5 km in class 4. Similarly the entire classified length of Wince Brook is class 3 (LTO class 2) and that of Moston Brook is class 4 (LTO class 2). On a brighter note, large parts of Whit Brook and Luzley Brook do meet their LTOs of class 2 (Appendix 2).

It is clear that storm sewage overflows have a serious impact on the quality of the R Irk. The work presented in this report describes the first detailed study of the river carried out in wet weather conditions.

2. SURVEY STRATEGY

The survey was designed to investigate the changes in the water quality of the R Irk which take place during wet weather. Because of manpower and analytical restrictions the study on Wince Brook and the R Irk upstream of Wince Brook was limited to their bottom reaches.

Separate dye injections were made during the early part of the survey to Wince Brook via Oldham ETW final effluent and also direct to the watercourse adjacent to Kirkway SSO (SD872 056). Dye was also injected into the R Irk downstream of Heaton Mills (Map A).

Automatic samplers were used on the R Irk at the Gasworks site (SD872 056), the R Irk upstream of BICC (SD850 028), and the R Irk at Scotland Weir (SJ841 991). Samples of the R Irk upstream of Wince Brook, and Wince Brook upstream of the R Irk, were taken from McBrides' premises at regular intervals until dye from the 2 injections upstream had cleared Wince Brook.

Further samples were taken at strategic points between Wince Brook and Moston Brook in an attempt to more clearly understand the reasons for the changes observed at the fixed sites, and in particular to gain information on the relative impact of particular groups of storm sewage overflows on the water quality of the R Irk.

Because water quality can change very quickly in times of storm, the time of travel information gathered during the survey would be used as an aid to interpret water quality changes by comparing samples taken in-phase with injected dye.

3. SURVEY CONDITIONS

The survey took place following a period of cold showery weather as indicated by the flows recorded at Scotland Weir shown below:-

Flows measured at Scotland Weir (cumecs)

Date	Time	Minimum	Time	Maximum
12/4/86	08.30	1.5	16.00	1.9
13/4/86	06.45	1.5	17.30	3.6
14/4/86	09.30	1.9	22.45	2.4
15/4/86	08.30	1.8	15.30	6.3

NB: DWF approx 1.1 cumecs at Scotland Weir

On 15 April 1986 the following observations were made on the weather:-

Time	Observation
06.30 - 08.30 hrs	very light drizzle
10.30	light rain commenced
11.45 - 11.55	very heavy rain
13.20	rain stopped

NB: The rainfall recorder at Heaton Park recorded 4.2mm of rain between 10.50-13.20 hrs with 1.6mm occurring between 11.35-12.05 hrs.

Fig 1 shows the very large increase in flows which took place during the survey period at Scotland Weir. Gaugings carried out on the day of the survey are shown in Table 1. Flows measured by dilution gauging are approximate due to lack of complete flow-through records at some sites.

River temperatures were low, generally in the range 5.5 - 7.5^{o}C.

4. TIME OF TRAVEL RESULTS

Time of travel results are summarised in Table 2 and plotted in Figs 2a, 2b and demonstrate the marked increase in river velocity which occurred following heavy rain.

Utilising these results, Tables 3-5 have been derived summarising some of the changes in water quality which took place during the survey. Samples taken at times close to when peak dye concentrations were present are highlighted in the tables.

5. RESULTS AND DISCUSSION

A summary of the results for all the samples taken during the survey is given in Appendix 3. Tables 3-5 highlight some of the changes in water quality which took place during and after rainfall on this survey. The river system has been split into five sections for discussion purposes as follows:-

(i) Wince Brook upstream of R Irk
(ii) R Irk upstream of Wince Brook
(iii) R Irk from Wince Brook to immediately upstream BICC's premises
(iv) R Irk from BICC to Moston Brook confluence
(v) R Irk from Moston Brook to Scotland Weir

(i) Wince Brook upstream of R Irk

During dry weather conditions, the final effluent discharge from Oldham ETW contributes almost all the flow in Wince Brook as measured upstream of the R Irk (section 1).

At the beginning of this survey, before significant quantities of rain had fallen, the water quality of Wince Brook was as expected with elevated ammonia levels (3.7 - 4.0 mgl^{-1}) but relatively low BOD (5.4 - 6.0 mgl^{-1}) and suspended solids levels (13 - 16 mgl^{-1} total).

Samples taken at the ptc R Irk site between 11.30 - 12.30 hrs, when rainfall was most intense, showed little change in water quality apart from a drop in ammonia concentrations (to 2.3 mgl^{-1}) presumably due to dilution as river flows increased. Clearly, the Kirkway SSO MN34 (SD872 056) was either not discharging or was not having significant effect on water quality at this time.

NB: The time of travel between this SSO and the sampling

site downstream was only 12 minutes even before significant rain had begun. Only one observation of the Kirkway SSO was made during the survey. This was at 08.30 hrs at the end of a period of very light drizzle and the SSO was not discharging.

Between 11.20 hrs and 13.30 hrs, flows in Wince Brook more than doubled (Table 1). By 13.30 hrs water quality in Wince Brook upstream of the R Irk had already begun to deteriorate with ammonia (3.2 mgl^{-1}), BOD (15.6 mgl^{-1}), and suspended solids levels (67 mgl^{-1} total, 33 mgl^{-1} mineral) all increasing significantly. The 13.30 hrs sample was in phase with the dye injection at Oldham ETW at 11.00 hrs, giving a time of travel of 2.5 hours under these elevated flow conditions. The corresponding sample taken at Oldham ETW (final effluent) at 11.15 hrs had lower ammonia (1.8 mgl^{-1}), suspended solids (20 mg^{-1} total), and BOD (10.2 mgl^{-1}) contents suggesting a significant input of ammonia and BOD from storm sewage overflows to Wince Brook.

At 14.00 hrs, ammonia and suspended solids levels in Wince Brook ptc R Irk were unchanged from 13.30 hrs but the BOD had increased further to 23 mgl^{-1} (Figs 3, 4 and 5).

No more samples were taken at this site until 16.00 hrs by which time BOD (13.8 mgl^{-1}) and suspended solids (36 mgl^{-1} total) levels had dropped but ammonia concentrations (6.2 mgl^{-1}) had almost doubled to reach levels higher than found prior to the increase in flows. It seems unlikely that discharges from SSOs would result in these increased ammonia levels (but not corresponding BODs) and hence the most likely source of these elevated ammonia levels is an increased load from Oldham ETW.

Oldham ETW is an activated sludge plant. There are biological filters at the works which normally treat all the flow to the works, but when flows exceed about 100 Mld^{-1}

some of the secondary tank effluent by-passes the filters and goes direct to river and this effluent will have a relatively high ammonia content.

Incidentally, during this survey, the Oldham ETW storm tanks operated for about half an hour just before 15.00 hrs (ie 14.30-15.00 hrs approx). However, samples taken of the storm tank effluent at 15.00 hrs (BOD 71 mgl^{-1}, NH_4-N 3.6 mgl^{-1}, suspended solids (total) 209 mgl^{-1}) and of the final (humus tank) effluent at 14.15 hrs (BOD 8.2 mgl^{-1}, NH_4-N 1.9 mgl^{-1}, suspended solids (total) 16 mgl^{-1}) suggest that neither the storm tank nor the fully treated final effluent discharge was the source of the elevated ammonia levels observed later in the survey upstream of the R Irk.

A sample from Wince Brook taken upstream of Oldham ETW at 13.40 hrs had little ammonia (0.6 mgl^{-1}) but extremely high suspended solids levels (1776 mgl^{-1} total, 1446 mgl^{-1} mineral) and an elevated BOD (48 mgl^{-1}). These results are probably attributable to civil works being carried out upstream. The flow in Wince Brook upstream of Oldham ETW was relatively low and these very elevated suspended solids were not seen at the Wince Brook ptc R Irk site during the sampling period.

(ii) R Irk upstream of Wince Brook

Limited sampling of the R Irk upstream of Whit Brook (at Hanson Street) and of Whit Brook ptc R.Irk (at John Lee Fold) demonstrated a substantial deterioration in water quality at both sites following heavy rain especially in terms of BOD and suspended solids levels (Appendix 3).

Thus prior to the storm Whit Brook ptc R Irk was of satisfactory quality (BOD 2.2-3.8 mgl^{-1}, NH_4-N 0.2 mgl^{-1}, SS (total) 5-13 mgl^{-1}, SS (mineral) 2-4 mgl^{-1}), whilst

further upstream, above Chadwick and Smith, close to the outskirts of Middleton but downstream of Stake Hill Industrial Estate and Castleton ETW, Whit Brook was of even better quality (BOD 0.5 mgl^{-1}, NH_4-N 0.15 mgl^{-1} SS (total) 11 mgl^{-1}, SS (mineral) 7 mgl^{-1}). However; at 15.40 hrs more than 2 hours after rainfall had stopped, BOD (13.6 mgl^{-1}), ammonia (1.85 mgl^{-1}), and SS (120 mgl^{-1} total, 85 mgl^{-1} mineral) had all increased significantly at the Whit Brook ptc R Irk site, although dissolved oxygen levels (87%) remained satisfactory. It seems likely that worse conditions would have occurred earlier in the storm at this site which is downstream of a number of SSOs.

Prior to the storm, the R Irk upstream of Whit Brook had an elevated ammonia content (2.4-4.0 mgl^{-1}) but satisfactory BOD (3.2-4.8 mgl^{-1}) and suspended solids (7-11 mgl^{-1} total) levels. Royton ETW final effluent will have made a significant contribution to the elevated ammonia levels found. The large SSO (MN34) off Spring Vale just upstream of Hanson Street bridge was not discharging when inspected at 07.45 hrs and 10.50 hrs.

By 15.30 hrs conditions were much worse (BOD = 24 mgl^{-1}, NH_4-N = 4.6 mgl^{-1}, SS (total) = 171 mgl^{-1}, SS (mineral) = 100 mgl^{-1}) as a consequence of the storm which had finished some 2 hours earlier. From a consideration of the results found at the Gasworks site (see below) it is possible that much worse conditions in terms of BOD and suspended solids levels would have occurred at this site between 13.00-14.00 hrs.

Downstream of Whit Brook, regular samples were taken from the R Irk at the Gasworks site (SD872 056), mainly using an automatic sampler, and also from just upstream of the Wince Brook confluence (McBrides' site - SD876 055). The results of samples taken prior to the storm indicate that there was

an input to the river in the culvert between these sites resulting in an increase in both BOD (3.5 to 7.0 mgl^{-1}) and ammonia (1.7 to 2.4 mgl^{-1}). There are 2 SSOs (MN26 - Long Street Roundabout, Middleton and MN36 - Wood Street, Middleton) which are possible sources. There was also a surcharge relief on the town centre sewer at this time which has subsequently been removed by the Middleton Town Centre sewer scheme in 1986.

At the beginning of the storm, this downstream deterioration was maintained until around 12.30 hrs when the water quality of the R Irk upstream of the Gasworks site became so bad that it would have tended to mask the impact of any input in the culverted section. Thus after about 12.30 hrs, BOD and suspended solids levels rose dramatically (Figs 3 and 4) to attain peaks in excess of 60 mgl^{-1} (BOD) and 500 mgl^{-1} (SS total) at both sites in the period 13.30-14.00 hrs. This situation contrasts with that found in Wince Brook where increases in BOD values were smaller (max observed BOD 23 mgl^{-1}), and suspended solids levels remained relatively low (< 70 mgl^{-1}, total) during the same period.

Interestingly, a routine river survey was carried out during the previous month (4 March 1986) during spate conditions when similar water quality was found for the R Irk upstream of Wince Brook (SS total = 548 mgl^{-1}, BOD = 39 mgl^{-1}). The results of this survey are shown in Table 6. The samples, whilst not in-phase, do indicate that the R Irk upstream of the Cedar Grove SSO was badly polluted in terms of suspended solids (860 mgl^{-1} total, 688 mgl^{-1} mineral), BOD (40 mgl^{-1}), and ammonia (4.7 mgl^{-1}). Further downstream, below Royton ETW and Luzley Brook the ammonia concentration (5.0 mgl^{-1}) found was almost double that immediately upstream of the works, but the BOD (38 mgl^{-1}) remained unchanged. In fact the BOD values found at all sites on the R Irk were in the range

34-40 mgl^{-1}, and suspended solids levels were also very high ($>$ 300 mgl^{-1} at all sites) especially in the reaches upstream of Wince Brook. Suspended solids in Wince Brook (184 mgl^{-1} total, 96 mgl^{-1} mineral) were much higher than on the subsequent intensive survey but appreciably lower than the corresponding values in the R Irk ptc Wince Brook (548 mgl^{-1} total, 394 mgl^{-1} mineral). Peak flows (8.9 cumecs, 770 Mld^{-1}) at Scotland Weir occurred around midday on 4/3/86. The sample taken at Scotland Weir at 14.15 hrs when the flow was still 8 cumecs had a substantially higher ammonia content (6.3 mgl^{-1}) than the corresponding samples on the intensive survey.

Samples taken from the R Irk at the Gasworks site during the intensive survey demonstrated an increase in ammonia concentration some time after the rain had stopped and at a time when BOD and suspended solids levels were falling (Figs 3,4,5). The peak values ($\sim$ 4.0 mgl^{-1} NH_4-N) measured were higher than the values found prior to rain at this site ($<$ 2 mgl^{-1}) and occurred at a time when ammonia levels in Wince brook were also elevated. Royton ETW, an activated sludge plant, is one likely source of the ammonia peak observed on the R Irk.

Finally the decrease in nitrate concentrations between the Gasworks site and the R Irk ptc Wince Brook site cannot be explained and it seems likely that these nitrate results are suspect.

(iii) R Irk from Wince Brook to just upstream BICC

Prior to the storm, the water quality of the R Irk at Lever Bridge was as expected from the quality found in the R Irk and Wince Brook upstream of their confluence, with elevated ammonia (3.1 mgl^{-1}) and phosphate (2.3 mgl^{-1}) concentrations, but fairly low BOD (6 mgl^{-1}) and suspended

solids levels (12 mgl^{-1} total). The three samples taken at Lever Bridge between 08.40-09.27 hrs failed to detect the very high BOD (96 mgl^{-1}) and COD (164 mgl^{-1}) values reported for the R Irk just upstream of Wince Brook at 08.40 hrs. As the time of travel between the Wince Brook confluence and Lever Bridge was around 20 minutes before rainfall began, the results suggest that there was either a very localised (possibly incompletely mixed) input to the R Irk just upstream of Wince Brook, or the results reported for the upstream site are erroneous.

A sample taken just before 13.00 hrs, towards the end of the storm, demonstrated a deterioration in water quality at Lever Bridge in terms of BOD (15 mgl^{-1}) and suspended solids (62 mgl^{-1} total) thought to be due principally to the deterioration in the R Irk upstream of Wince Brook. At this time lots of sewage solids were clearly visible in the R Irk at Lever Bridge.

Between Lever Bridge and Heaton Mills, Boardman Brook enters the R Irk. This was sampled before the onset of the storm and was found to be of excellent quality. Because of manpower restrictions, no further water quality samples were taken from this watercourse which, although very small, has at least 3 SSOs on its upper reaches.

At Heaton Mills the water quality of the R Irk prior to the storm was very similar to that found at Lever Bridge in terms of BOD and suspended solids levels, although dissolved oxygen (83%) and ammonia ($\sim$ 3.7 mgl^{-1}) concentrations were somewhat higher (samples not in phase). At 11.45 hrs there had been little change in water quality apart from a drop in ammonia (to 2.8 mgl^{-1}) due to increased dilution, and even at 12.45 hrs, well into the storm, BOD (7.4 mgl^{-1}) and suspended solids (32 mgl^{-1} total) levels had not increased markedly. However, sewage solids were visible in the river

on each hourly visit to this site between 11.45-13.45 hrs, pointing to the operation of local SSOS upstream (storm sewage overflows MN1 at SD844 047, and MN2 at SD846 049 are well within 1 km of the sampling site, whilst MN24 at SD850 050 is not much more than 1 km upstream). Clearly the impact of these SSOs on the water quality of the R Irk was small during the early part of the storm (excluding visual effects).

Between 12.45-13.45 hrs there was a substantial deterioration in the water quality of the R Irk at Heaton Mills in terms of BOD (7.4 to 47 mgl^{-1}) and suspended solids (32 to 219 mgl^{-1} total, 14 to 127 mgl^{-1} mineral). The large twin outfall SSO (MN32 located at SD856 053) constructed in 1981 adjacent to Manchester Old Road, close to the Boardman Brook confluence, and approximately 2 km upstream of the Heaton Mill site, commenced discharging at 12.00 hrs and would have contributed to this observed deterioration. It is highly unlikely that the very bad conditions observed in the R Irk upstream of Wince Brook would have reached Heaton Mills by 13.45 hrs (recall that the BOD and SS levels at Lever Bridge, almost 3 km upstream of Heaton Mills, were relatively low at 15 mgl^{-1} and 62 mgl^{-1} (total) respectively around 13.00 hrs).

Samples taken by the automatic sampler located at the upstream end of BICC's premises and in-phase samples (Table 3) demonstrated that water quality at this site was very similar to that found at Heaton Mills (approx 2.6 km upstream) in the early part of the survey. However, the first sample taken at BICC after the onset of rain (composite of 11.30 and 12.00 hrs samples) showed a significant deterioration in terms of BOD (15.8 mgl^{-1}) indicating that a polluting discharge(s) had entered the river downstream of Heaton Mills (see Table 4).

The 13.45 hrs sample (composite of 13.30 and 14.00 hrs samples) showed a substantial deterioration in water quality (BOD $>$ 25 mgl^{-1}) but it is not possible to deduce the relative importance of the contributions from local SSOs, from the new Manchester Old Road SSO (MN32), or even from resuspension of river bed deposits. Fig 3 shows the variation of BOD with time at this site. Highest BOD (44 mgl^{-1}) COD (189 mgl^{-1}) and suspended solids (445 mgl^{-1} total, 299 mineral) concentrations measured occurred in the period 15.15-15.30 hrs. Peak BODs found around 13.30 hrs in the R Irk upstream of Wince Brook would have arrived at BICC around this time.

It is postulated that the changes in water quality observed at BICC were due initially to the early operation of local SSOs (downstream of Heaton Mills), possibly so close to the BICC site as to be not properly mixed, followed by the impact of SSOs downstream of Lever Bridge (with MN32 thought to be particularly important), and that subsequently the impact of the R Irk input (from upstream of Wince Brook) became significant.

Because regular sampling of Wince Brook was terminated at 14.00 hrs before BOD levels began to fall, it is not possible to gauge how bad the Wince Brook input became following the storm. However, whilst the 14.00 hrs sample of Wince Brook was bad (BOD = 23 mgl^{-1}) and the flow high (approx 2.8 cumecs at 13.30 hrs), the corresponding R Irk quality was so bad on this survey that the Wince Brook input at this time would have resulted in a net improvement in the water quality of the R Irk downstream of the Wince Brook confluence.

Ammonia concentrations in the R Irk upstream of BICC followed the pattern shown at the Gasworks site with a gradual increase occurring several hours after peak BOD and

suspended solids levels were found (Figs 3,4,5). The highest ammonia concentration (4.8 mgl^{-1} for the 20.00-20.30 hrs composite) found in the R Irk immediately upstream of BICC was higher than the peak value found at the Gasworks site (4.0 mgl^{-1}) and also higher than the pre-storm ammonia values at both these sites (3.8 mgl^{-1} and 2.3 mgl^{-1} respectively). This points to a substantial input of ammonia from the Wince Brook catchment as flows receded, as indicated by the 16.15 hrs sample (NH_4-N = 6.2 mgl^{-1}) taken from Wince Brook just upstream of the R Irk confluence (see Section 5(i)).

(iv) R Irk from BICC to Moston Brook

Samples taken at the upstream ICI Blackley site prior to the storm indicated no significant change in water quality from that found at the BICC site.

Boggart Hole Clough, which enters the R Irk below ICI was very badly polluted before the storm (BOD $>$ 80 mgl^{-1}, NH_4-N = 9.2 mgl^{-1} at 10.15 hours), being grey in appearance and smelling of sewage. This watercourse was subsequently sampled at 12.30 hrs after heavy rain when the appearance and BOD (3.8 mgl^{-1}) were much improved, but the ammonia level (8.4 mgl^{-1}) was still surprisingly high. However, as the flow in this brook was only 1.5 Mld^{-1} at 13.40 hrs, it is not surprising that this input did not cause a discernible downstream deterioration in the R Irk.

Thus, samples taken from the R Irk downstream of ICI site (and below Boggart Hole Clough) at 10.25 hrs before appreciable rainfall were not significantly different from the corresponding in-phase sample taken upstream of BICC (Table 3). Later samples taken at the d/s ICI site at 11.50 hrs and 12.40 hrs, at which times small quantities of sewage solids were visible in the R Irk, did not show the

same elevated BODs as found at the BICC site, possibly indicating that the dischage(s) causing the elevated BODs at BICC earlier in the storm were close to the sampling site and hence not properly mixed. Whilst there is no chemical evidence of a significant polluting input between the BICC and d/s ICI sites during the early part of the storm, the presence of sewage solids in the river at the d/s ICI site at 11.50 hrs indicates that either the SSO upstream of BICC began discharging very early in the storm or that there were other small discharge(s) from SSOs downstream of the BICC site.

At Hendham Vale, 1.4 km further downstream, all samples were taken after rain had begun and showed a downstream deterioration when compared with the corresponding samples taken at the d/s ICI site (Table 3). There was a marked deterioration in water quality at Hendham Vale between 11.10hrs (BOD = 9.3 mgl^{-1}) and 11.40 hrs (BOD = 27 mgl^{-1}) which was maintained at 12.45 hrs (BOD = 22 mgl^{-1}). Sewage solids were observed at this site on each occasion that it was sampled with the appearance of the R Irk being worst around 11.30-11.40 hrs. The 11.40 hrs sample at Hendham Vale (BOD = 27 mgl^{-1}) was roughly in-phase with the 10.25 hrs sample taken d/s ICI (BOD = 7.2 mgl^{-1}) confirming the input of storm sewage between these sites. Clearly a SSO close to the Hendham Vale site operated very early in the storm.

All samples from the R Irk just upstream of Moston Brook were also taken after heavy rain had begun. Considering time of travel results it is noted that BOD values (10-14 mgl^{-1}) before 14.00 hrs were less than expected from the results and Hendham Vale. This is probably a consequence of the SSO input upstream of Hendham Vale being incompletely mixed at that site.

Between 11.55 hrs when the site was first visited and 13.55 hrs, small quantities of sewage solids were visible in the R Irk just upstream of Moston Brook. However, by 14.55 hrs the R Irk had deteriorated in terms of both water quality (BOD = 25 mgl^{-1}) and appearance. This sample was approximately in-phase with the samples taken at Lever Bridge at 09.10 hrs (BOD = 6 mgl^{-1}) and BICC at 13.00 hrs (BOD = 14.4 mgl^{-1}) and indicates that a significant input occurred between the BICC and upstream Moston Brook sites. The cumulative effect of the SSOs downstream of BICC together with resuspension of river bed deposits (the river flow was increasing rapidly at this time - Fig 1) is the most likely explanation of the deterioration observed.

An hour later (at 15.55 hrs) conditions were worse with BOD (49 mgl^{-1}) and SS (226 mgl^{-1} total, 129 mgl^{-1} mineral) increasing markedly. By this time, it is feasible that discharges from the Manchester Old Road SSO (MN32) would have reached this site contributing to the further deterioration observed.

(v) R Irk from Moston Brook to Scotland Weir

The first sample taken from Moston Brook was at 12.00 hrs, about 1.5 hrs after rainfall began. By this time, Moston Brook was already badly polluted (BOD = 25 mgl^{-1}, NH_4-N = 2.4 mgl^{-1}), with sewage solids being clearly visible in the brook. Water quality and appearance subsequently deteriorated further so that by 13.00 hrs the BOD had increased to 85 mgl^{-1} and both sewage solids and oil were visible in this watercourse.

Worst conditions (BOD = 441 mgl^{-1}, SS (total) = 1158 mgl^{-1}, SS (mineral) = 512 mgl^{-1}, NH_4-N = 3.5 mgl^{-1}, DO = 26%) were found at 14.00 hrs when the river was in spate. Sampling at this site was terminated at 16.00 hrs,

some 2.5 hrs after rainfall had ceased, at which time conditions were still very bad (BOD = 61 mgl^{-1}, SS (total) = 234 mgl^{-1}, SS (mineral) = 120 mgl^{-1}). Clearly Moston Brook is very badly affected by the numerous SSOs which discharge into it.

Almost all the samples of the R Irk at Scotland Weir were taken by an automatic sampler. The automatic sampler was switched on at 12.10 hrs by which time sewage solids were already clearly visible in the river at this site. River flows had only just started to rise around 12.00 hrs at this site (Fig 1). By 13.20 hrs there were large quantities of sewage solids swirling around behind the weir.

The results of samples (mainly composites) taken at Scotland Weir showed the R Irk to be badly polluted throughout the sampling period (12.10-23.40 hrs), BODs remaining in excess of 20 mgl^{-1} for a minimum of 9 hours and probably much longer. However, because of the nature of the river and the cold temperatures prevailing during the survey, dissolved oxygen levels remained at acceptable values throughout the storm (range 68-81%) at this site.

The time of travel between Moston Brook and Scotland Weir would have been between 15-40 minutes during the sampling period depending on the river flow. A comparison of the water quality found in the R Irk just upstream of Moston Brook with that found at Scotland Weir demonstrates that the bad conditions found at the downstream site before 14.00 hrs must have been due to the Moston Brook input together with further inputs from the many SSOs which discharge to the R Irk downstream of Moston Brook. Worst conditions at Scotland Weir in terms of BOD (>51 mgl^{-1}), COD (296 mgl^{-1}), and suspended solids (243 mgl^{-1} total, 112 mgl^{-1} mineral) were found at 14.25 hrs (composite of 14.10 and 14.40 hrs samples), roughly in-phase with the

appalling (BOD = 441 mgl^{-1}) Moston Brook conditions at 14.00 hrs.

Ammonia concentrations at Scotland Weir showed a similar trend to that found at the BICC site upstream with values rising after 20.00 hrs (Fig 5) a considerable time after peak BOD and suspended solids levels were measured (14.10 + 14.40 hrs composite sample). By the end of the sampling period (23.10 + 23.40 hrs composite sample), ammonia concentrations (4.4 mgl^{-1}) were the highest found at this site during the survey.

At Scotland Weir flow is recorded continuously and hence ammonia loads can be calculated. Highest loads were found during periods of highest flows when SSOs would have been operating but when ammonia concentrations were lowest as a consequence of the dilution avialable. However, highest ammonia concentrations were found when flows had dropped but when ammonia loads were increasing at the end of the survey. It is thought likely that the increased ammonia loads originated at the Royton and, in particular, Oldham ETWs (see earlier sections 5(i) and 5 (ii)).

The very high suspended solids levels found in the R Irk upstream of Wince Brook (max $\sim$ 600 mgl^{-1} total) and further downstream at the BICC site (max $\sim$ 450 mgl^{-1} total) had attenuated by Scotland weir. Nevertheless, suspended solids concentrations measured in the composite samples taken remained in excess of 200 mgl^{-1} (range 220-260 mgl^{-1}) for almost 5 hours in the period 14.00-19.00 hrs when flows exceeded 3 cumecs. The organic content of these solids was substantial (70-100 mgl^{-1}).

Clearly the high load of organic material (and associated BOD) passing from the R Irk in times of storm will make an impact on the R Irwell (and Manchester Ship Canal) downstream especially during periods of warm weather.

6. SUMMARY AND RECOMMENDATIONS

1. A water quality study was carried out on the R Irk on 15 April 1986 during a period of unsettled weather. During the early part of the survey rain fell for around 3 hours with very intense rainfall for a short period around midday. This resulted in a rapid increase in flows throughout the catchment (Table 1, Fig 1).

2. Prior to the rainfall, the water quality of Wince Brook upstream of the R Irk reflected the dominating influence of Oldham ETW with elevated ammonia levels (3.7-4.0 mgl^{-1}) but relatively low BODs (5.4-6.0 mgl^{-1}) being found.

3. Upstream of Whit Brook, the R Irk had an elevated ammonia content (2.4-4.0 mgl^{-1}) as a consequence of the Royton ETW discharge but associated BODs (3.2-4.8 mgl^{-1}) were relatively low.

5. Although Whit Brook deteriorated in quality between the outskirts of Middleton (BOD 0.5 mgl^{-1}, ammonia 0.15 mgl^{-1}) and the R Irk confluence, conditions at John Lee Fold just upstream of the R Irk were, nevertheless, satisfactory (BOD 2.2 - 3.8 mgl^{-1}, ammonia 0.25 mgl^{-1}) prior to the storm.

5. Early in the survey, the Whit Brook input led to an improvement in the condition of the R Irk downstream at the Gasworks site where ammonia concentrations were reduced. However, there was a further increase in both ammonia and BOD levels by the time the R Irk reached Wince Brook. Three possible sources which could discharge to the R Irk in the culverted section between these sites were SSO MN26 (Long Street Roundabout), SSO MN36 (Wood Street) and the surcharge relief on the Middleton Town Centre sewer. The latter should not have been operating in the dry conditions early in the

survey and has since been closed as part of the Middleton Town Centre sewers project (2-32-35-203).

6. Below the Wince Brook confluence, conditions in the R Irk prior to the storm were as expected from the upstream inputs. Thus BODs measured were around 6-7 mgl^{-1} whilst ammonia concentrations were in the range 3-4 mgl^{-1} in the stretch down to ICI Blackley, reflecting the importance of the Oldham and Royton ETW discharges in dry weather (all samples downstream of this stretch were taken after the onset of rain).

7. Prior to significant rain, Boardman Brook was of good quality but Boggart Hole Clough was badly polluted (BOD >80 mgl^{-1}, ammonia 9.2 mgl^{-1}) by sewage, although it had little impact on the much larger R Irk. Boggart Hole Clough was later sampled biologically (on 18 June 1986) when the faunal composition was indicative of organic pollution and a strong smell of disinfectant was evident. Clearly conditions in this brook are bad on a regular basis.

   Moston Brook was not sampled until after the onset of rain.

8. There was a massive deterioration in the water quality of the R Irk after the onset of rain in terms of BOD and suspended solids. Sewage solids were recorded at every site on the R Irk below Wince Brook at some stage during the survey. Records were not kept at the Wince Brook ptc R Irk and R Irk ptc Wince Brook sites, but it seems likely that sewage solids were visible at both sites following heavy rain.

   Wince Brook is an official SIP (No 4,71 points) and from the observations made during this survey there would appear to be a good argument for reinstating the whole of the length of the R Irk downstream of Wince Brook as an official SIP.*

* This has now been done as part of the River Protection SIP Review exercise in 1987.

Certainly conditions were very poor visually at Lever Bridge around13.00 hrs, and furtherdownstream the large twin outfall SSO (MN32) adjacent to Manchester Old Road discharged substantial volumes of crude sewage to the R Irk from 12.00 hrs until after 13.15 hrs causing a significant deterioration in water quality.

9. Despite the sewerage schemes carried out in the Irk valley in recent years, conditions in the R Irk upstream of Wince Brook deteriorated badly during the storm. Early in the storm there was a noticeable deterioration in water quality between the Gasworks site and the ptc Wince Brook site which may be attributable to the same source that caused the dry weather difference or may be related to the surcharge relief on the Middleton Town Centre sewer which existed at that time.

The main contribution to the much worse conditions (BOD $>$ 60 mgl^{-1}, SS (total) $>$ 500 mgl^{-1}) which occurred in the R Irk above Wince Brook towards the end of the storm originated upstream of the Gasworks site. No information is available from this survey as to the relative importance of the Spring Vale SSO (MN34 - just upstream of the Hanson Street site), other SSOs further upstream, Royton ETW, or of resuspension of river bed deposits. Further investigations are required to clarify this situation.

10. However, the results of a routine river survey carried out in spate conditions on 4 March 1986 demonstrate that, on that occasion, the R Irk at the top of its classified reach and upstream of the Cedar Grove SSO was badly polluted (BOD 40 mgl^{-1}, SS (total) 860 mgl^{-1}, ammonia 4.7 mgl^{-1}, DO 72%), and that the net effect of the various inputs down the R Irk was to maintain this poor quality (Table 6). Clearly further work is required on the R Irk upstream of Wince Brook to ascertain the important pollutant sources in wet weather conditions.

11. There was a deterioration in the water quality of Wince Brook following the heavy rain presumably as a consequence of the impact of SSOs within the catchment. However, the deterioration was not as marked as found on the R Irk above Wince Brook. Thus although BODs did exceed 20 mgl^{-1}, suspended solids levels measured remained relatively low (< 70 mgl^{-1} total).

12. Whit Brook was not sampled during the storm, but a sample taken almost 2.5 hrs after rain had stopped showed a significant deterioration in water quality (BOD 14 mgl^{-1} ammonia 1.9 mgl^{-1}, SS (total) 129 mgl^{-1}). It is not known how bad conditions became during the storm in this watercourse.

13. Ammonia levels in both Wince Brook and the R Irk upstream of their confluence increased significantly several hours after peak BODs had been found, and this effect was noted further downstream in the R Irk at the BICC site and also at Scotland Weir. These elevated ammonia concentrations are likely to have arisen from increased ammonia loads discharged from Oldham and Royton ETWs at a time when river flows were receding.

14. Downstream of Wince Brook, there was evidence (visual) of the early operation of SSOs upstream of Heaton Mills (MN1, MN2, and MN24 possible sources). Volumes discharged in the early part of the storm are likely to have been small as there was little impact on the water quality of the R Irk at this time.

15. However, later on the large SSO (MN32) adjacent to Manchester Old Road commenced discharging (at 12.00 hrs) and there is evidence to suggest that this overflow caused a substantial deterioration in the quality of the R Irk downstream prior to the arrival of the polluting slug from the R Irk catchment upstream of Wince Brook.

16. The water quality of the R Irk upstream of BICC deteriorated early in the storm due to a discharge(s) to the river downstream of Heaton Mills, probably close to BICC's premises.

17. Similarly sewage solids were seen early in the storm at the d/s ICI and Hendham Vale sites. The solids seen at the d/s ICI site must have originated either close to BICC very early in the storm, or from an SSO downstream of BICC. The solids seen at Hendham Vale originated from an SSO downstream of the d/s ICI site, probably very close to the Hendham Vale site (as there is evidence that the SSO discharge was not fully mixed at Hendham Vale).

18. Moston Brook was found to be badly polluted by sewage (BOD 25 mgl^{-1}) and visually poor (sewage solids) when first sampled some 1.5 hours after rainfall began. The condition of the brook subsequently deteriorated further so that 2 hours later, when the watercourse was in spate, it was grossly polluted (BOD 441 mgl^{-1}, SS (total) 1158 mgl^{-1}, SS (mineral) 512 mgl^{-1}). At this time the dissolved oxygen level in Moston Brook was only 26% which is by far the lowest value recorded on the survey.

19. The very poor conditions in the R Irk at Scotland Weir both chemically and visually were much worse than those at the R Irk upstream of Moston Brook site until after the storm had finished. This highlights the polluting impact on the R Irk of the many SSOs in the Moston Brook and the R Irk downstream of Moston Brook catchments. These SSOs must have been operating early in the storm. Later on, the poor water quality at Scotland Weir would have been maintained by pollutants emanating from the Manchester Old Road SSO (MN32) and subsequently pollution sources upstream of the Wince Brook/ R Irk confluence together with the effects of resuspended river deposits as river velocities increased with increase in flow.

20. Thus conditions were bad at Scotland Weir for a considerable time following the onset of rain. BODs remained above 20 mgl^{-1} for at least 9 hours, whilst suspended solids levels remained in excess of 200 mgl^{-1} (total) with an organic content of around 100 mgl^{-1} for almost 5 hours, during which period flows exceeded 3 cumecs. There was no significant impact of this large oxygen demand on oxygen levels in the R Irk due, in part at least, to the low river temperatures at the time of the survey.

21. However, between April - October 1986 a water quality monitoring station located at Scotland Weir has monitored dissolved oxygen levels in the R Irk continuously (ref 1). During this period low oxygen levels have been found ($<$ 20% saturation on occasions). Worst conditions in terms of oxygen levels have occurred after prolonged dry spells and following fairly minor rainfall events which were presumably sufficient to initiate the operation of SSOs without causing flows (and hence dilution and reaeration in the river) to rise substantially. It should be noted that the high organic solids load passing from the R Irk catchment in times of storm discharges to the R Irwell/Manchester Ship Canal downstream where its oxygen demand will eventually be exerted.

Dr R Ward
Assistant Water Quality Planner (East)

REFERENCE

1. Wells G R, "Water Quality Monitoring Stations 1983-6". NWW Planning and Engineering Directorate, Chief Scientific Advisor's Section, Report No WQW 87/1.

TABLE 1

GAUGED FLOWS ON THE R IRK CATCHMENT - 15/4/86
(Locations in downstream order)

TIME	RIVER	LOCATION	NGR	FLOW		METHOD
				CUMECS	Ml/d	
08.45	Wince Brook	ptc R Irk	SD 867 056	0.64	55	Dilution gauging
11.20	"	"	"	1.1	93	Current meter
13.20	"	"	"	2.8	240	Dilution gauging
10.50	Irk	Hanson St u/s Whit Beck	SD 875 060	0.37	32	Current meter
09.00	Irk	Lever Br d/s Wince Brook	SD 865 053	1.1	98	Dilution gauging
12.10	Irk	d/s SSO MN32	SD 855 052	2.1	178	Current meter
09.30	Irk	u/s BICC	SD 847029	1.5	125	Dilution gauging
13.20	Irk	ICI culvert	SD 851 028	1.9	166	Current meter
13.40	Boggart Hole Clough	ptc Irk	SD 854 024	0.018	1.5	Current meter
14.15	Irk	u/s Moston Brook	SD 850 002	3.2	280	Current meter
15.00	Irk	Scotland Weir	SJ 841 992	5.6	486	Current meter

* Moston Brook was in spate around 14.00 hrs and could not be safely gauged

TABLE 2

TIME OF TRAVEL RESULTS - R IRK 15/4/86

SITE	DISTANCE UPSTREAM R IRWELL	BATCH 1	BATCH 2	BATCH 3
Oldhám ETW (Wince Brook)	15.0			Inject 25g RhWT into final effluent at 11.00 hrs
Wince Brook opposite Kirkway SSO	12.2		Inject 25g RhWT at 08.30 hrs	
Wince Brook ptc R Irk	11.8		Dye peak at 08.42 hrs (150 ugl^{-1})	Dye peak at 13.32 hrs (12.2 ugl^{-1})
R Irk at Lever Bridge	11.4		Dye peak at 09.02 hrs (40 ugl^{-1})	
R Irk d/s Heaton Mills	8.5	Inject 25g RhWT at 07.45 hrs	Dye peak missed (1.0 ugl^{-1} at 11.45 hrs)	
R Irk u/s BICC	5.9	Dye peak around 09.27 hrs (12.8 ugl^{-1})	Dye peak around 13.00 hrs (2.0 ugl^{-1} at 12.30 hrs) (3.4 ugl^{-1} at 13.00 hrs)	Dye peak at 15.30 hrs (3.0 ugl^{-1} at 15.30 hrs)
R Irk d/s ICI	4.5	Just missed dye peak (9.8 ugl^{-1} at 10.22 hrs)		
R Irk d/s Hendham Vale	3.1	Terminate sampling just prior to dye peak (7.1 ugl^{-1} at 11.41 hrs)		
R Irk u/s Moston Brook	1.7	Missed dye peak (0.7 ugl^{-1} at 12.52 hrs)	Sample close to dye peak (3.4 ugl^{-1} at 14.55 hrs)	
R Irk at Scotland Weir	0.5	Sample close to dye peak (7.0 ugl^{-1} at 13.10 hrs)	Sample close to dye peak (1.4 ugl^{-1} at 15.10 hrs)	Dye peak around 17.40 hrs (2.7 mgl^{-1} at 17.40 hrs)

TABLE 2

VARIATION IN WATER QUALITY DOWN THE R IRK
(in-phase samples underlined)

Results in mg. per litre unless otherwise stated

Sampling Point	Time taken	Estimated time of dye peak	pH	Conductivity µS	Chloride Cl.	Alkalinity as $CaCO_3$ p.p.	Alkalinity as $CaCO_3$ m.o.	Nitrogen as N NH_3	Nitrogen as N NO_2	Nitrogen as N NO_3	o-phosphate P	Permanganate Value (27°C) 3 mins	Permanganate Value (27°C) 4hrs	C.O.D	BOD (5 days at 20°C) suppressed	Suspended solids (dried at 105°C) total	Suspended solids (dried at 105°C) ash	Dissolved Oxygen	Dissolved Oxygen % Sat.n	Temp °C	Comments
R Irk d/s Heaton Mills	07.40	Inject dye at 07.45hrs	7.7	546	73			3.9	.26	2.0	2.5			39	6	13	3	10.3	83	5.8	Dry
R. Irk upstream BICC	09.30	09.27hrs	7.7	574	71			3.5	.30	1.7	2.4			43	6	10	<2	10	80	5.7	Dry
R Irk upstream ICI	10.00	estd. 09.40hrs	7.6	626	70		100	3.5	.30	1.6	2.4			42	6.2	11	3	10.1	81	5.8	Dry
Boggart Hole clough ptc R. Irk	10.15	estd. 10.05hrs	7.8	936	75			9.2	.06	.7	1.6			300	>80	27	14	8.3	66	5.5	Strong sewage present
R. Irk downstream ICI	10.25	estd. 10.15hrs	7.9	536	71			3.5	.30	1.6	2.4			42	7.2	13	5	9.9	80	6.0	Dry
R Irk at Hexham Vale	11.40	estd. 11.45hrs	7.6	582	87			3.6	.28	1.2	2.2			75	27	35	4	9.8	79	6.0	Heavy rain strong sewage solids
R. Irk upstream Moston Brook	11.55	estd. 12.25 hrs	7.6	633	74		110	3.5	.30	2.1	2.3			56	10	18	4	9.8	79	6.2	Heavy rain small amount sewage solids
"	12.55	"	7.6	499	67			2.8	.28	6.6	2.0			48	11.4	32	13	9.8	79	6.2	Rain small amount sewage solids
Moston Brook ptc Irk	12.00	estd. 12.25	7.6	654	55			2.4	.12	1.3	.05			76	25	53	20	9.7	79	6.2	Heavy rain very strong sewage present
	13.00	"	8.2	528	41		175	2.8	.12	1.0	.50			240	85	160	79	7.8	64	7.0	Rain Oil and stump present
R. Irk at Scotland Weir	13.25	13.10hrs	7.5	668	76			2.9	.30	5.4	1.9			128	37	83	31	8.5	69	6.5	Rain stopped Large quantities of sewage solids present

TABLE 3

VARIATION IN WATER QUALITY DOWN THE R IRK
(in-phase samples underlined)

Results in mg. per litre unless otherwise stated

Sampling Point	Time taken	Estimated time of dye peak	pH	Conductivity µS	Chloride Cl.	Alkalinity as $CaCO_3$ p.p.	Alkalinity as $CaCO_3$ m.o.	Nitrogen as N NH_3	Nitrogen as N NO_2	Nitrogen as N NO_3	o-phosphate P	Permanganate Value (27°C) 3 mins	Permanganate Value (27°C) 4hrs	C.O.D	BOD (5 days at 20°C)	Suspended solids (dried at 105°C) total	Suspended solids (dried at 105°C) ash	Dissolved Oxygen	Dissolved Oxygen % Sat.n	Temp °C	Comments
Wince Brook opposite Kirkway 550		Inject dye at 08.30hrs																			
Wince Brook pre Irk	08.55	08.42hrs	7.2	603	81			4.0	.26	5.0	3.25			44	5.4	44	14	7.1	58	6.5	Dry
R. Irk pre Wince Brook	09.05	08.42hrs	7.9	505	47		110	2.4	.12	3.6	1.15			31	6.2	12	<2	10.9	87	5.5	Dry
R. Irk at Lever bridge	09.10	09.02hrs	7.5	573	68			3.1	.20	4.4	2.3			42	6	12	2	8.7	69	5.8	Dry
Boardman Brook pre Irk	10.12	09.40 hrs	7.7	450	37			<1.05	.02	.75	<1.05			22	1.8	2	<2	11.5	92	5.2	Dry
R. Irk d/s Heaton mills	11.45	approx. 11.05hrs	7.7	568	68			2.8	.26	3.8	2.2			48	6.4	18	6	10.6	85	6.2	Heavy rain. Sewage solids visible
R. Irk u/s BICC	11.45		7.6	609	64		95	2.7	.26	2.5	2.1			75	16	—	—	—	—	—	Composite of 11.30 + 12.00 hrs
" " "	12.45	approx. 13.00hrs	7.8	532	95			2.5	.26	2.2	2.0			55	14	—	—	—	—	—	Composite of 12.30 + 13.00 hrs
" " "	13.45		7.8	556	68			2.6	.28	2.1	2.1			108	>25	—	—	—	—	—	Composite of 13.30 + 14.00 hrs
R. Irk u/s Moston Brook	13.55		7.7	430	63			2.4	.26	6.5	1.9			62	14	42	17	9.6	78	6.5	Rain stopped. Small amount of fresh sewage solids
"	14.55	approx 14.40 hrs	7.6	435	62		90	2.3	.28	6.6	1.8			92	25	102	56	9.7	79	6.7	Lots debris
"	15.55		7.6	513	68			2.3	.24	5.7	1.7			208	49	226	129	9.0	75	7.5	Sunny
Moston Brook pre Irk	14.00		7.2	429	38			3.5	.28	.25	.9			1340	441	1158	512	3.1	26	6.7	In spate
"	15.00	approx 14.40hrs	7.3	315	24			2.3	.10	.90	.4			476	141	602	320	6.7	55	6.5	In spate
"	16.00		7.3	353	23		85	1.6	.10	1.1	.2			209	61	234	120	9.0	74	7.0	
R. Irk at Scotland weir	14.25		7.2	558	60		110	3.0	.30	3.4	1.5			296	>51	243	112		68	7.2	composite of 14.10 + 14.40 hrs
"	15.25	approx 15.10 hrs	7.4	479	59			2.3	.32	4.8	1.7			153	>24	225	129		80	7.7	composite of 15.10 + 15.40 hrs
"	16.25		7.3	516	62			2.5	.30	4.6	1.6			164	>24	257	153		79	7.5	composite of 16.10 + 16.40 hrs

TABLE 4

VARIATION IN WATER QUALITY DOWN THE R IRK
(In-phase samples underlined)

Results in mg. per litre unless otherwise stated

Sampling Point	Time taken	Estimated time of dye peak	pH	Conductivity µS	Chloride Cl.	Alkalinity as $CaCO_3$ p.p.	Alkalinity as $CaCO_3$ m.o.	Nitrogen as N NH_3	Nitrogen as N NO_2	Nitrogen as N NO_3	o-phosphate P	Permanganate Value (27°C) 3 mins	Permanganate Value (27°C) 4hrs	C.O.D	BOD (5 days at 20°C)	BOD (5 days at 20°C) suppressed	Suspended solids (dried at 105°C) total	Suspended solids (dried at 105°C) ash	Dissolved Oxygen	Dissolved Oxygen % Sat.n	Temp °C	Comments
Oldham ETW final effluent discharging to Wince Brook	11.15	Inject dye at 11.00hrs	7.5	579	81			1.8	.22	10.2	2.6			57		10	20	5	8.9	74	7.5	Rain
Wince Brook pfe R. Irk	12.30		7.2	615	101			2.3	.24	3.9	2.7			55		6.9	22	8	7.3	59	6.5	Rain
"	13.30	13.32hrs	7.2	541	76		70	3.2	.22	3.0	2.4			83		16	67	33	7.4	61	6.7	Rain stopped
"	14.00		7.2	551	73			3.1	.20	2.5	2.3			129		23	67	36	7.3	60	6.7	
R. Irk pfe Wince Brook	12.30		7.9	456	46			2.8	.14	1.5	1.1			80		17	64	32	10.6	84	5.8	Rain
"	13.30	estd: 13.30hrs	7.8	437	47			2.8	.14	2.0	1.0			212		63	593	355	10.1	81	6.0	Rain, stopped
"	14.10		7.8	302	33		75	2.7	.10	1.0	.8			284		51	413	273	9.7	79	6.7	
R. Irk at Lever Bridge	12.58	estd. 13.40hrs	7.5	554	74			2.2	.20	3.7	1.9			72		15	62	32	8.7	71	6.2	Rain. River high Lots of flotsam & jetsam
R. Irk d/s Heaton Mills	13.45	estd. 14.40 hrs	7.4	500	68			2.4	.22	3.5	1.9			159		47	219	127	10.1	82	6.6	Rain stopped SSO mh 32 discharging Lots of flotsam & jetsam
R. Irk u/s BICC	14.45		7.4	487	64		75	2.2	.22	3.2	1.6			148		37	247	156	9.4	76	6.2	Dry River turbid Some flotsam visible
"	15.15		7.4	482	59			2.2	.22	1.7	1.4			189		31	445	299				"
"	15.30	~ 15.30hrs	7.5	497	60			2.7	.22	2.2	1.4			189		44	386	248				"
"	16.20		7.5	435	53		80	3.0	.16	1.6	1.3			169		37	279	175	9	73	6.2	"
R. Irk u/s Moston Brook	15.55	estd. 17.12hrs	7.6	513	68			2.3	.24	5.7	1.7			208		49	226	129	9	75	7.5	
Moston Brook u/s R. Irk	16.00	estd. 17.12hrs	7.3	353	23		85	1.6	.10	1.1	.2			209		61	234	120	9	74	7.0	
R. Irk at Scotland Weir	16.25		7.3	516	62			2.5	.30	4.6	1.6			164		24	257	153		79	7.5	
"	17.25	~ 17.40hrs	7.4	494	58		90	2.4	.28	4.5	1.3			145		45	233	134		87	7.4	
"	18.25		7.4	254	53			3.0	.22	2.4	1.2			203		41		157				

TABLE 5

ROUTINE R IRK SURVEY - 4 MARCH 1986

WATER QUALITY SAMPLE SUMMARIES

REQUEST NO 1

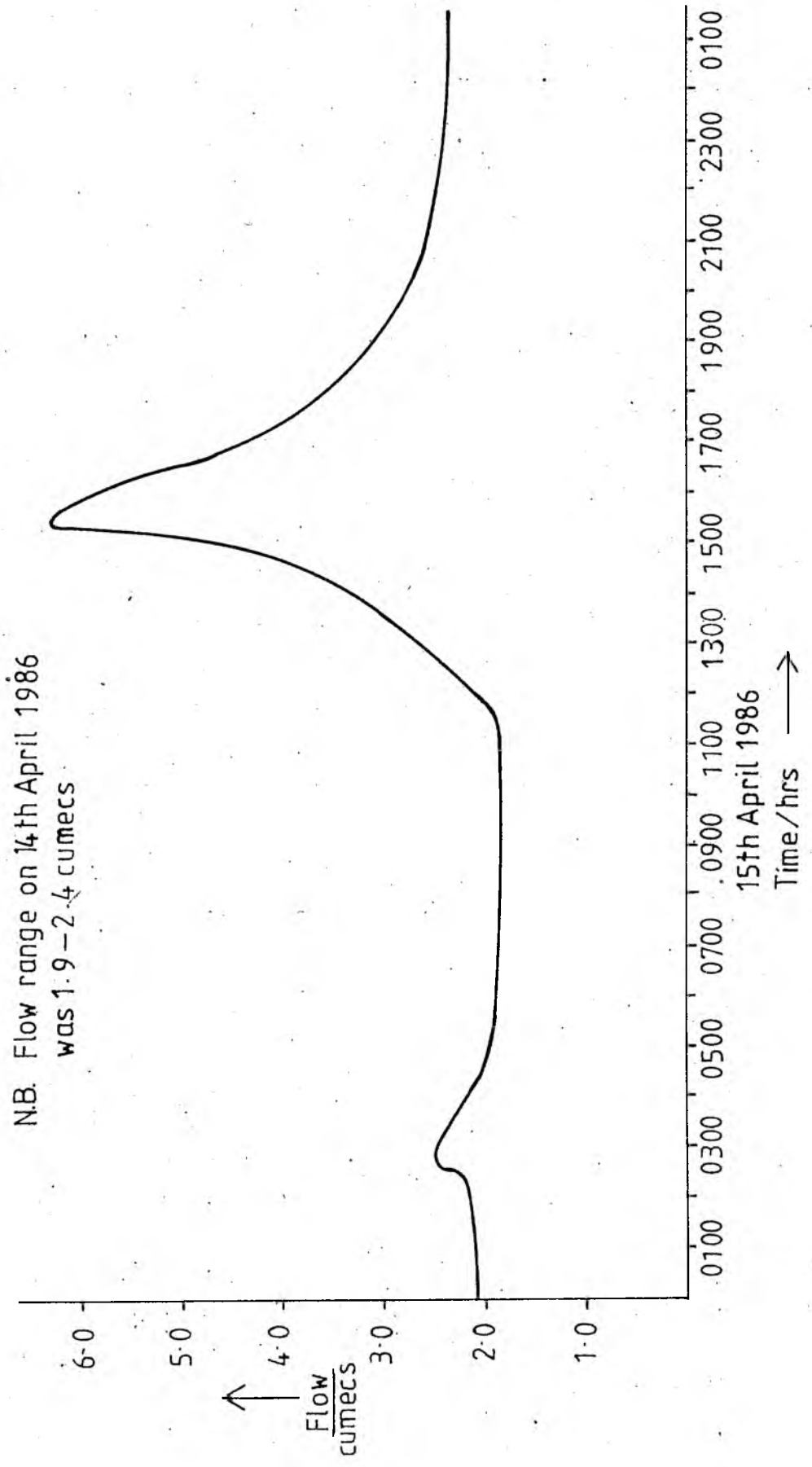
SAMPLE DATE TIME	WTH1 WEATHER PAST WEEK	WTH2 WEATHER TIME OF SAMP	PURP OF SAMP	76 TEMP WATER DEG C	61 PH PH	82 DISS OXYGN MG/L O	81 DISS OXYGN % SATN	111 AMMONIA MG/L N	118 NO2-N MG/L N	117 NO3-N MG/L N	180 ORTHO PHOSPHATE MG/L P	85 BOD5 ATU MG/L O	92 COD MG/L O	135 SUS SOLS MG/L	143 SOLS NON-VOL 500C MG/L	162 ALKAL INITY M.O. MG/L CACO3	172 CHLORIDE MG/L CL	77 COND AT 25C US/CM	461 ANION SNDET MOT MG/L	37 FLOW INST M3/S
<------><-->																				
SPT :- 0169801609			NGR :- SD 92000 08700	RIVER IRK U/S OF CEDAR GROVE SSO																
040319861030 ABM	BBE	NSAR	4	7.08	9.4	72	4.65	.16	3.25	.6	40	279	860	688	100	75	528			
SAMPLERS COMMENT-							ANALYSTS COMMENT- SPATE													
SPT :- 0169801610			NGR :- SD 90650 07200	RIVER IRK ABOVE ROYTON EFFLUENT TREATMENT WORKS																
040319861045 ABM	BBE	NSAR	4	7.23	9.8	75	2.7	.08	1.45	.5	38	235	458	320	60	82	495			
SAMPLERS COMMENT-							ANALYSTS COMMENT- SPATE													
SPT :- 0169801640			NGR :- SD 90300 06900	RIVER IRK AT STREET BRIDGE BELOW ROYTON E.T.W.																
040319861100 ABM	BBE	NSAR	4	7.28	10.3	78	5	.12	2.35	.95	38	195	345	244	75	150	792			
SAMPLERS COMMENT-							ANALYSTS COMMENT- SPATE													
SPT :- 0169801650			NGR :- SD 87450 06000	RIVER IRK AT HANSON BRIDGE ABOVE CONFLUENCE WITH WHIT BROOK																
040319861135 ABM	BBE	NSAR	4	7.31	8.9	68	5	.14	2.35	.9	45	279	544	370	80	174	899			
SAMPLERS COMMENT-							ANALYSTS COMMENT- SPATE													
SPT :- 0169801680			NGR :- SD 87000 05800	RIVER IRK ABOVE OSWALD STREET BRIDGE ABOVE WINCE BROOK																
040319861145 ABM	BBE	NSAR	4	7.32	9.5	72	4.35	.16	2.1	.8	39	246	548	394	80	191	951			
SAMPLERS COMMENT-							ANALYSTS COMMENT- SPATE													
SPT :- 0169801700			NGR :- SD 86800 05550	WINCE BROOK ABOVE CONFLUENCE WITH RIVER IRK																
040319861200 ABM	BBE	NSAR	4	7.08	6.9	53	6.35	.22	3.95	1.5	34	196	184	96	85	256	1216			
SAMPLERS COMMENT-							ANALYSTS COMMENT- SPATE													
SPT :- 0169801770			NGR :- SD 85100 01100	RIVER IRK AT HENDHAM VALE																
040319861345 ABM	BBE	NSAR	4	7.31	9	68	6.2	.22	3.15	1.35	34	200	313	210	95	206	1038			
SAMPLERS COMMENT-							ANALYSTS COMMENT- SPATE													
SPT :- 0169801780			NGR :- SD 85100 00100	MOSTON BROOK UPSTREAM OF RIVER IRK																
040319861400 ABM	BBE	NSAR	4	7.41	9.4	72	2.6	.14	1.6	.4	50	192	197	127	90	102	696			
SAMPLERS COMMENT-							ANALYSTS COMMENT- SPATE													
SPT :- 0169801790			NGR :- SJ 84100 99200	RIVER IRK AT RED BANK ABOVE SCOTLAND WEIR																
040319861415 ABM	BBE	NSAR	4	7.35	8.9	68	6.25	.2	2.9	1.45	40	204	305	201	95	178	967			8.36
SAMPLERS COMMENT-							ANALYSTS COMMENT- SPATE													

TABLE 6

R.IRK SURVEY – 15TH APRIL 1986

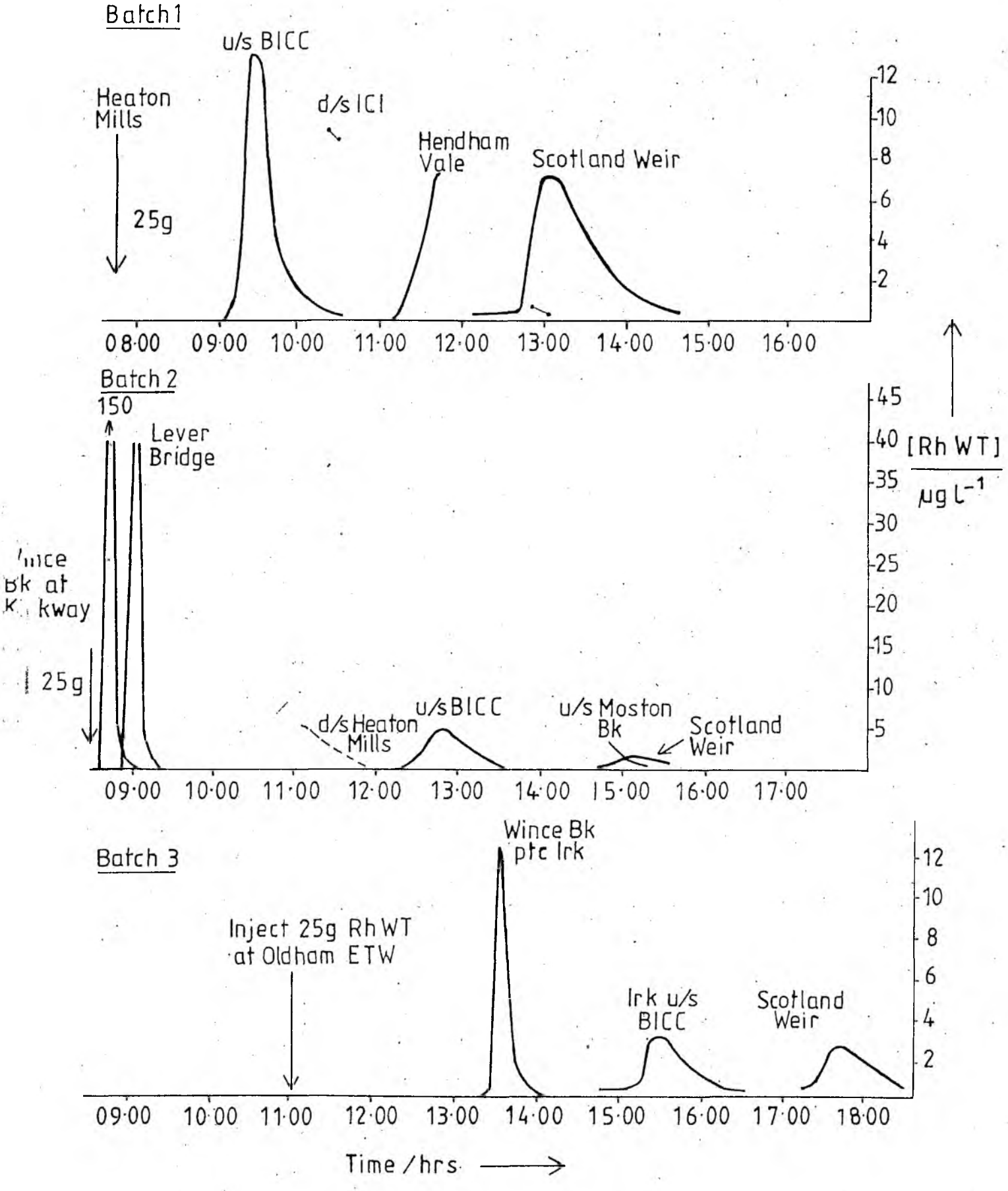
FIG.1

VARIATION OF FLOW WITH TIME AT SCOTLAND WEIR



R.IRK SURVEY-15TH APRIL 1986 FIG 2b

TIME OF TRAVEL RESULTS RHODAMINE WT CONCENTRATIONS



R.IRK SURVEY-15TH APRIL 1986

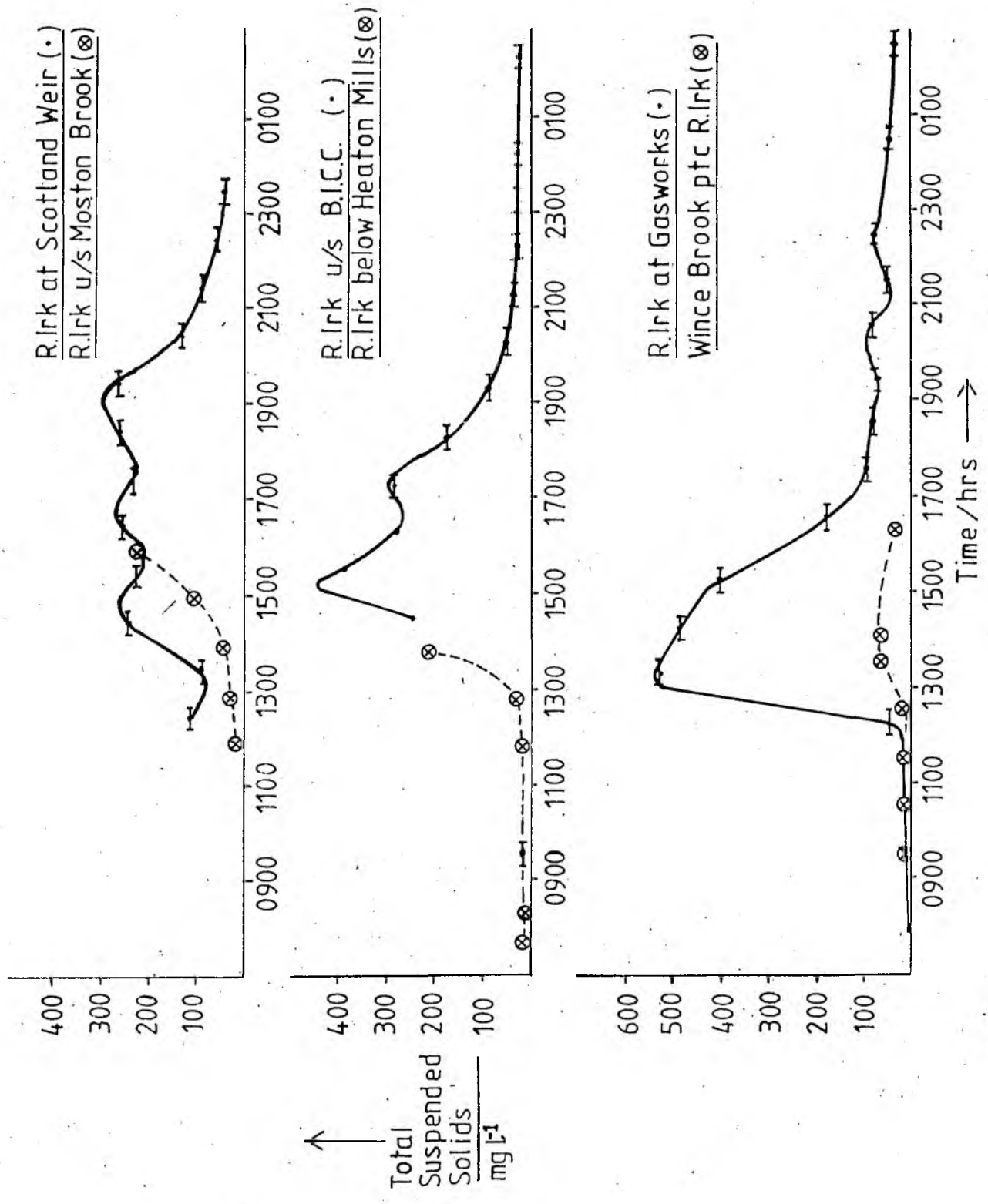
VARIATION OF BOD WITH TIME

FIG.3

R.IRK SURVEY-15th APRIL 1986

FIG.4

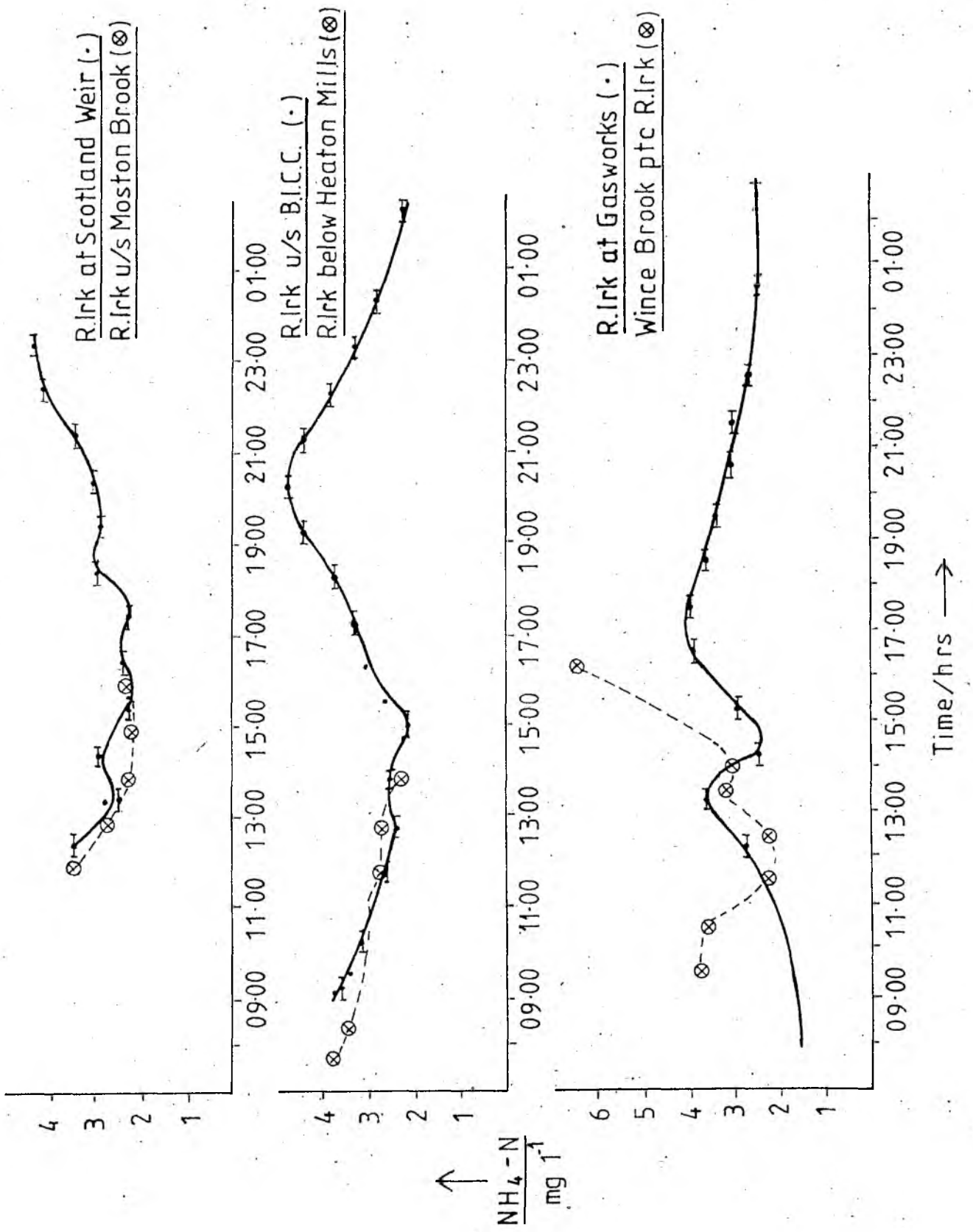
VARIATION OF SUSPENDED SOLIDS (TOTAL) WITH TIME



R.IRK SURVEY–15TH APRIL 1986

FIG.5

VARIATION OF AMMONIA WITH TIME



APPENDIX 1

SCHEMES CARRIED OUT IN RECENT YEARS IN THE UPPER IRK CATCHMENT (ROCHDALE AND OLDHAM MBC AREAS)

ROCHDALE MBC AREA

Manchester Old Road Sewer	(2.32.35.082)
Wood Street SSO and SW Sewer	(2.32.35.081)
Wince Brook Sewer	(2.32.35.080)
SWQ Irk Sewer - Middleton	(2.32.35.095)
Whit Brook Sewer	(2.32.35.100)
SWQ Oldham Road/Spring Vale - Middleton Sewer Replacement	(2.32.35.093)
Long Street Sewer	(2.32.35.114)

and, since the survey described in this report

Middleton Town Centre	(2.32.35.203)

OLDHAM MBC AREA

SWQ Irk Vale Sewer Replacement	(2.32.31.104)
SWQ Royton Southern Stage 2	(2.32.31.100)
Middleton Road Chadderton	(2.32.31.109)
North Chadderton Stages 1 and 2	(2.32.31.219)

and, since the survey described in this report:

Royton Southern Stage 3	(2.32.31.123)

IRK CATCHMENT

RIVER CLASSIFICATION SHOWING TARGET (LTO) CLASS (1986 DATA)

069-050-1081-0070-000-000-000-000-000-000 000.001 TO 006.502 LENGTH 6.501 KM INLAND RIVER CLASS 4 TARGET 2
FROM SJ 8380098900 RIVER IRK @ RIVER IRWELL
TO SD 8420003000 RIVER IRK @ BOWKER BANK
++++

069-050-1081-0070-000-000-000-000-000-000 006.502 TO 018.404 LENGTH 11.902 KM INLAND RIVER CLASS 3 TARGET 2
FROM SD 8420003000 RIVER IRK @ BOWKER BANK
TO SD 9170008300 RIVER IRK @ A671 ROYTON
++++

069-050-1081-0070-000-000-000-000-000-000 018.404 TO 019.056 LENGTH 0.652 KM INLAND RIVER CLASS 2 TARGET 2
FROM SD 9170008300 RIVER IRK @ A671 ROYTON
TO SD 9210008700 RIVER IRK @ LOW CROMPTON
++++

069-050-1081-0070-000-000-000-000-000-000 019.056 TO 019.528 LENGTH 0.472 KM INLAND RIVER CLASS 2 TARGET B
FROM SD 9210008700 RIVER IRK @ LOW CROMPTON
TO SD 9260008700 QUALITY SURVEY LIMIT ON RIVER IRK @ SOURCE
++++

069-050-1081-0070-010-000-000-000-000-000 000.000 TO 005.638 LENGTH 5.638 KM INLAND RIVER CLASS 4 TARGET 2
FROM SJ 8490499905 CONFLUENCE OF MOSTON BROOK AND RIVER IRK
TO SD 8925001850 QUALITY SURVEY LIMIT ON MOSTON BROOK @ HALE LANE FAILSWORTH
++++

069-050-1081-0070-040-000-000-000-000-000 000.000 TO 003.746 LENGTH 3.746 KM INLAND RIVER CLASS 3 TARGET 2
FROM SD 8672405462 CONFLUENCE OF WINCE BROOK WITH RIVER IRK.
TO SD 8960004600 QUALITY SURVEY LIMIT ON WINCE BROOK @ FOXDENTON LANE
++++

069-050-1081-0070-051-000-000-000-000-000 000.001 TO 004.472 LENGTH 4.471 KM INLAND RIVER CLASS 2 TARGET 2
FROM SD 8730006000 WHIT BROOK @ RIVER IRK
TO SD 8800009600 QUALITY SURVEY LIMIT ON TRUB BROOK @ CASTLETON STW
++++

069-050-1081-0070-051-010-000-000-000-000 000.001 TO 000.613 LENGTH 0.612 KM INLAND RIVER CLASS 3 TARGET 2
FROM SD 8765007100 WHIT BROOK @ TRUB BROOK
TO SD 8810007400 QUALITY SURVEY LIMIT ON TRIB OF WHIT BROOK @ SD881074
++++

069-050-1081-0070-051-010-010-000-000-000 000.001 TO 001.739 LENGTH 1.738 KM INLAND RIVER CLASS 4 TARGET 2
FROM SD 8810007400 WHIT BROOK TRIB @ WHIT BROOK
TO SD 8950007900 QUALITY SURVEY LIMIT ON TRIB OF TRIB OF WHIT BROOK @ STAKE HILL R
++++

69-050-1081-0070-070-000-000-000-000-000-000-001 TO 003.300 LENGTH 3.299 KM INLAND RIVER CLASS 2 TARGET 2
SD 9060007100 LUZLEY BROOK @ RIVER IRK
SD 9330008400 QUALITY SURVEY LIMIT ON LUZLEY BROOK @ SHAW
++++

APPENDIX 2

WATER QUALITY SAMPLE SUMMARIES

REQUEST NO 1

SAMPLE DATE	TIME	WTH1 WEAT-HER PAST WEEK	WTH2 WEAT-HER TIME OF SAMP	PURP PURP OF SAMP	76 TEMP WATER DLG C	61 PH PH	82 DISS OXYGN MG/L O	81 DISS OXYGN % SATN	111 AMMON IA MG/L N	118 NO2-N MG/L N	117 NO3-N MG/L N	180 ORTHO PHOS PHATE MG/L P	85 BOD5 ATU MG/L O	92 COD MG/L O	135 SUS SOLS MG/L	143 SOLS NON-VOL 500C MG/L	162 ALKAL INITY M.O. MG/L CACO3	172 CHLOR IDE MG/L CL	77 COND AT 25C US/CM	461 ANION SNDET OT MG/L	37 FLOW INST M3/S
<------><-->																					
SPT :- 0169801690				NGR :- SD 89600 04600					WINCE BROOK FOXDENTON LANE ABOVE OLDHAM E.T.W												
150419861340	BAB		BAF	SSAT	7	8.93	5.8	48	.55	.08	.9	.1	121	636	1776	1446		27	357		
SPT :- 0169502304000				NGR :- SD 89246 04372					OLDHAM STW FINAL EFFLUENT												
150419861115	BAB		BAB	SSZT	7.5	7.47	8.9	74	1.75	.22	10.15	2.6	10.2	57	20	5		81	579		
150419861415	BAB		BAF	SSZT		7.09	8.8		1.85	.18	8.7	2.25	8.2	54	16	<2		78	583		
SPT :- 0169801700				NGR :- SD 86800 05550					WINCE BROOK ABOVE CONFLUENCE WITH RIVER IRK												
150419860855	BAB		BAB	SSAT	6.5	7.16	7.1	58	3.95	.26	5	3.25	5.4	44	14	5		81	603		
150419860930	BAB		BAB	SSAT	6.5	7.19	7.1	58	3.8	.26	4.5	3.2	6	50	13	4		80	599		
150419861030	BAB		BAB	SSAT	6.5	7.21	7.4	60	3.65	.26	4.5	3.15	6	45	16	4	80	79	589		
150419861130	BAB		BAB	SSAT	6.5	7.21	7.5	61	2.3	.26	4.5	3	7.2	57	22	8		97	627		
150419861230	BAB		BAG	SSAT	6.5	7.21	7.3	59	2.3	.24	3.85	2.7	6.9	55	22	8		101	615		
150419861330	BAB		BAG	SSAT	6.7	7.21	7.4	61	3.2	.22	3	2.4	15.6	83	67	33	70	76	541		
150419861400	BAB		BAG	SSAT	6.7	7.21	7.3	60	3.1	.2	2.5	2.25	23	129	67	36		73	551		
150419861615	BAB		BAF	SSAT	7	7.56	8	66	6.5	.14	6.15	2.1	13.8	67	36	15	100	73	573		
SPT :- 0169801650				NGR :- SD 87450 06000					RIVER IRK AT HANSON BRIDGE ABOVE CONFLUENCE WITH WHIT BROOK												
150419860745	BAB		BAB	SSAT	5.5	7.39	10.4	82	2.4	.14	2	1.15	4.2	35	7	<2		55	540		
150419860940	BAB		BAB	SSAT	7	7.84	10.9	90	2.7	.1	4.95	1.25	3.2	28	9	<2	110	51	563		
150419861050	BAB		BAB	SSAT	6.1	7.55	10.5	84	4	.16	2.5	1.45	4.8	32	11	<2	125	60	596		
150419861530	BAB		BAF	SSAT	7	7.81	9.8	81	4.55	.1	2.35	1.05	24	123	171	100		33	386		
SPT :- 0169801660				NGR :- SD 87600 06900					WHIT BROOK ABOVE CHADWICK AND SMITH												
150419860715	BAB		BAB	SSAT	4.7	7.8	10.9	84	.15	.08	.9	.45	<.5	16	11	7	80	45	329		
SPT :- 0169801670				NGR :- SD 87400 06200					WHIT BROOK ABOVE CONFLUENCE WITH RIVER IRK												
150419860735	BAB		BAB	SSAT	4.9	7.75	11.3	88	.25	.08	2.4	.45	2.2	24	13	4		44	401		
150419860930	BAB		BAB	SSAT	6	7.9	11.9	96	.25	.08	3.55	.55	2.9	23	8	<2	90	42	425		
150419861040	BAB		BAE	SSAT	5.3	7.85	11.6	92	.25	.08	2.35	.5	3.8	36	5	<2		49	432		
150419861540	BAB		BAF	SSAT	7	7.84	10.6	87	1.85	.12	2.6	.65	13.6	91	129	85		26	297		
SPT :- 0169801677				NGR :- SD 87200 05600					R.IRK AT GASWORKS												
150419860755	BAB		BAB	SSAT	5.1	7.81	10.1	79	1.55	.12	3.15	.95	3.2	26	3	<2	110	51	510		
150419861030	BAB		BAB	SSAT		7.86			1.9	.12	5.85	1	3.8	31	12	5		51	511		
150419861215	BAB		BAF	SSAT		7.74			2.7	.12	6.1	1.15	9.6	64	46	26		49	520		
150419861315	BAB		BAF	SSAT		7.69			3.6	.14	6.2	1.05	52	90	535	329		43	461		
150419861415	BAB		BAF	SSAT		7.71			2.45	.1	4.15	.75	63	272	489	419	75	31	315		
150419861515	BAB		BAF	SSAT		7.75			2.95	.1	1.5	.75	34	52	406	279		29	296		
150419861630	BAB		BAG	SXAT		7.63			3.95	.1	2.35	.95	17.3	93	176	123	85	34	433		
150419861730	BAB		BAG	SXAT		7.61			4	.12	2.65	1	14	63	99	68		37	437		
150419861830	BAB		BAG	SXAT		7.68			3.7	.12	3.05	1.05	8	53	81	56	100	38	452		
150419861930	BAB		BAG	SXAT		7.69			3.45	.12	3.2	1.05	10.7	44	64	43		39	454		
150419862030	BAB		BAG	SXAT		7.71			3.1	.12	3.35	1	8.9	44	86	66		40	466		
150419862130	BAB		BAG	SXAT		7.74			3	.12	3.4	1	8.3	38	50	34	105	39	470		
150419862230	BAB		BAG	SXAT		7.75			2.7	.12	3.4	.95	7.1	36	72	59		39	460		
160419860030	BAB		BAG	SXAT		7.78			2.45	.12	3.45	1	7.1	35	41	22		40	472		
160419860230	BAB		BAG	SXAT		7.78			2.45	.12	.25	1	7.4	32	35	24	105	41	480		

APPENDIX 3

WATER QUALITY SAMPLE SUMMARIES

REQUEST NO 1

SAMPLE DATE	TIME	WTH1 WEAT-HER PAST WEEK	WTH2 WEAT-HER TIME OF SAMP	PURP OF SAMP	76 TEMP WATER DEG C	61 PH PH	82 DISS OXYGN MG/L O	81 DISS OXYGN % SATN	111 AMMONIA MG/L N	118 NO2-N MG/L N	117 NO3-N MG/L N	180 ORTHO PHOS PHATE MG/L P	85 BOD5 ATU MG/L O	92 COD MG/L O	135 SUS SOLS MG/L	143 SOLS NON-VOL 500C MG/L	162 ALKAL INITY M.O. MG/L CACO3	172 CHLOR IDE MG/L CL	77 COND AT 25C US/CM	461 ANION SNDET OT MG/L	37 FLOW INST M3/S
<------><-->																					
SPT :- 0169801680				NGR :- SD 87000 05800					RIVER IRK ABOVE OSWALD STREET BRIDGE ABOVE WINCE BROOK												
150419860840	BAB	BAB	SSAT	5.5	7.8	10.8	86	2.25	.12	3.55	1.15	96	164	21	9		48	494		
150419860905	BAB	BAB	SSAT	5.5	7.87	10.9	87	2.35	.12	3.55	1.15	6.2	31	12	<2	110	47	505		
150419860927	BAB	BAB	SSAT	5.5	7.91	10.9	86	2.65	.12	3.5	1.2	7	35	12	<2		49	509		
150419861030	BAB	BAB	SSAT	5.7	7.94	10.9	87	2.35	.12	3.5	1.1	7	32	14	6		50	517		
150419861130	BAB	BAB	SSAT	5.7	7.97	10.8	87	3.3	.14	2	1.35	14.7	55	35	14	115	52	459		
150419861230	BAB	BAG	SSAT	5.8	7.93	10.6	84	2.8	.14	1.5	1.05	17.4	80	64	32		46	456		
150419861330	BAB	BAG	SSAT	6	7.8	10.1	81	2.8	.14	2	1	63	212	593	355		47	437		
150419861410	BAB	BAG	SSAT	6.7	7.8	9.7	79	2.65	.1	1	.75	51	284	413	273	75	33	302		
SPT :- 0169801700				NGR :- SD 86800 05550					WINCE BROOK ABOVE CONFLUENCE WITH RIVER IRK												
150419860855	BAB	BAB	SSAT	6.5	7.16	7.1	58	3.95	.26	5	3.25	5.4	44	14	5		81	603		
150419860930	BAB	BAB	SSAT	6.5	7.19	7.1	58	3.8	.26	4.5	3.2	6	50	13	4		80	599		
150419861030	BAB	BAB	SSAT	6.5	7.21	7.4	60	3.65	.26	4.5	3.15	6	45	16	4	80	79	589		
150419861130	BAB	BAB	SSAT	6.5	7.21	7.5	61	2.3	.26	4.5	3	7.2	57	22	8		97	627		
150419861230	BAB	BAG	SSAT	6.5	7.21	7.3	59	2.3	.24	3.85	2.7	6.9	55	22	8		101	615		
150419861330	BAB	BAG	SSAT	6.7	7.21	7.4	61	3.2	.22	3	2.4	15.6	83	67	33	70	76	541		
150419861400	BAB	BAG	SSAT	6.7	7.21	7.3	60	3.1	.2	2.5	2.25	23	129	67	36		73	551		
150419861615	BAB	BAF	SSAT	7	7.56	8	66	6.5	.14	6.15	2.1	13.8	67	36	15	100	73	573		
SPT :- 0169801710				NGR :- SD 86500 05400					RIVER IRK AT LEVER BRIDGE												
150419860845	BAB	BAB	SSAT	5.5	7.6	8.4	67	3.1	.22	4.9	2.3	6.6	40	11	2		71	577		
150419860910	BAB	BAB	SSAT	5.8	7.54	8.7	69	3.05	.2	4.4	2.3	6	42	12	2		68	573		
150419860950	BAB	BAB	SSAT	6	7.52	8.5	68	3.15	.22	4.1	2.35	6.4	43	15	3	95	69	581		
150419861258	BAB	BAG	SSAT	6.2	7.48	8.7	71	2.15	.2	3.7	1.9	15	72	62	32		74	554		

APPENDIX 3 (Contd)

WATER QUALITY SAMPLE SUMMARIES

REQUEST NO 2

SAMPLE DATE	TIME	WTH1 WEAT- HER PAST WEEK	WTH2 WEAT- HER TIME OF SAMP	PURP OF SAMP	76 TEMP WATER DEG C	61 PH PH	82 DISS OXYGN MG/L O	81 DISS OXYGN % SATN	111 AMMON IA MG/L N	118 NO2-N MG/L N	117 NO3-N MG/L N	180 ORTHO PHOS PHATE MG/L P	85 BOD5 ATU MG/L O	92 COD MG/L O	135 SUS SOLS MG/L	143 SOLS NON- VOL 500C MG/L	162 ALKAL INITY M.O. MG/L CACO3	172 CHLOR IDE MG/L CL	.77 COND AT 25C US/CM	461 ANION SNDET OT MG/L	37 FLOW INST M3/S
<------><-->																					
SPT :- 0169801730				NGR :- SD 85900 05100					BOARDMAN BROOK UPSTREAM OF RIVER IRK												
150419861012	BAB	BAB	SSAT	5.2	7.7	11.5	92	<.05	.02	.75	<.05	1.8	22	2	<2		37	450		
SPT :- 0169801720				NGR :- SD 84150 04500					RIVER IRK BELOW HEATON MILLS												
150419860740	BBC	BAA	SSAT	5.8	7.68	10.3	83	3.85	.26	1.95	2.45	6	39	13	3		73	546		
150419860815	BBC	GBA	SSAT	6	7.65			3.5	.24	1.8	2.4	6.2	40	10	<2		68	550		
150419861145	BAB	BAG	SSAT	6.2	7.67	10.6	85	2.75	.26	3.75	2.2	6.4	48	18	6	90	68	568		
150419861245	BAB	BAG	SSAT	6.2	7.33	11	89	2.7	.24	3.45	2.1	7.4	48	32	14		65	561		
150419861345	BAB	BAG	SSAT	6.6	7.42	10.1	82	2.35	.22	3.5	1.85	47	159	219	127		68	500		
SPT :- 0169801738				NGR :- SD 84800 02900					R.IRK U/S BICC												
150419860910	BBC	BAA	SSAT	5.7	7.63	10	80	3.75	.3	1.75	2.45	6.8	40	11	2	105	72	603		
150419860915	BAB	BAB	SXAT		7.58			3.6	.3	2.6	2.4	6.8	41				71	599		
150419860930	BBC	BAA	SSAT	5.7	7.65	10	80	3.5	.3	1.7	2.4	6	43	10	<2		71	574		
150419861015	BAB	BAB	SXAT		7.68			3.15	.3	2.45	2.35	7.2	44				69	594		
150419861145	BAB	BAG	SXAT		7.63			2.65	.26	2.45	2.1	15.8	75			95	64	609		
150419861245	BAB	BAG	SXAT		7.8			2.45	.26	2.15	2	14.4	55				95	532		
150419861345	BAB	BAG	SXAT		7.75			2.55	.28	2.05	2.05	>25	108				68	556		
150419861445	BAB	BAG	SSAT	6.2	7.41	9.4	76	2.2	.22	3.15	1.6	37	148	247	156	75	64	487		
150419861515	BAB	BAG	SSAT		7.44			2.2	.22	1.7	1.4	31	189	445	299		59	482		
150419861530	BAB	BAG	SSAT		7.45			2.65	.22	2.2	1.4	44	189	386	248		60	497		
150419861620	BAB	BAG	SSAT	6.2	7.45	9	73	3	.16	1.55	1.25	37	169	279	175	80	53	435		
150419861715	BAB	BAG	SXAT		7.43			3.3	.2	2.7	1.1	>22.4	188	292	165		46	392		
150419861815	BAB	BAG	SXAT		7.49			3.75	.18	3	1.15	23.9	103	176	113		48	443		
150419861915	BAB	BAG	SXAT		7.58			4.45	.2	3.4	1.4	16.4	68	90	55	100	53	481		
150419862015	BAB	BAG	SXAT		7.59			4.8	.22	3.7	1.55	14.9	59	54	31		57	518		
150419862115	BAB	BAG	SXAT		7.6			4.45	.21	4.1	1.85	11.5	51	42	23		57	526		
150419862215	BAB	BAG	SXAT		7.61			3.85	.26	4.7	1.65	13.7	48	34	16	95	54	498		
150419862315	BAB	BAG	SXAT		7.59			3.3	.26	5.05	1.7	8.9	45	29	16		51	427		
160419860015	BAB	BAG	SXAT		7.59			2.85	.24	5.15	1.65	10.1	44	28	14		51	501		
160419860215	BAB	BAG	SXAT		7.58			2.2	.22	5.1	1.6	7.4	38	25	11	85	49	488		
SPT :- 0169801740				NGR :- SD 85000 02800					RIVER IRK ABOVE I.C.I BLACKLEY												
150419861000	BBC	BAA	SSAT	5.8	7.6	10.1	81	3.45	.3	1.6	2.35	6.2	42	11	3	100	70	626		
150419861225	BBC	BAE	SSAT	6.2	7.62	10	81	2.4	.28	1.55	2	9.9	56	24	6		62	556		
SPT :- 0169801750				NGR :- SD 85430 02400					BOGGART HOLE BROOK ABOVE CONFLUENCE WITH RIVER IRK												
150419861015	BBC	BAB	SSAT	5.5	7.76	8.3	66	9.2	.06	.7	1.55	>80	300	27	14		75	936		
150419861230	BBC	BAE	SSAT	5.5	7.96	10.5	83	8.35	.08	.7	<.05	3.8	38	15	11		64	788		
SPT :- 0169801760				NGR :- SD 85400 02100					RIVER IRK BELOW I.C.I.BLACKLEY												
150419861025	BBC	BAB	SSAT	6	7.89	9.9	80	3.5	.3	1.55	2.35	7.2	42	13	5	100	71	536		
150419861150	BBC	BAE	SSAT	6	7.78	9.9	80	2.75	.3	1.45	2.15	6.2	42	12	5		68	554		
150419861240	BBC	BAE	SSAT	6.2	7.69	9.9	81	2.4	.26	1.25	1.9	10.2	52	29	11		61	545		
SPT :- 0169801770				NGR :- SD 85100 01100					RIVER IRK AT HENDHAM VALE												
150419861110	BBC	BAE	SSAT	6	7.64	9.8	79	3.65	.3	1.25	2.3	9.3	45	12	<2	110	74	632		
150419861140	BBC	BAE	SSAT	6	7.61	9.8	79	3.6	.28	1.15	2.2	27	75	35	4		87	582		
150419861245	BBC	BAE	SSAT	6.2	7.62	9.9	80	2.65	.28	1.25	1.95	22	55	25	9		66	583		

APPENDIX 3 (contd)

WATER QUALITY SAMPLE SUMMARIES

REQUEST NO 2

SAMPLE DATE	TIME	WTH1 WEAT- HER PAST WEEK	WTH2 WEAT- HER TIME OF SAMP	PURP PURP OF SAMP	76 TEMP WATER DEG C	61 PH PH	82 DISS OXYGN MG/L O	81 DISS OXYGN % SATN	111 AMMON IA MG/L N	118 NO2-N MG/L N	117 NO3-N MG/L N	180 ORTHO PHOS PHATE MG/L P	85 BOD5 ATU MG/L O	92 COD MG/L O	135 SUS SOLS MG/L	143 SOLS NON- VOL 500C MG/L	162 ALKAL INITY M.O. MG/L CACO3	172 CHLOR IDE MG/L CL	77 COND AT 25C US/CM	461 ANION SNDET OT MG/L	37 FLOW INST M3/S
<-------><-->																					
SPT :- 0169801772				NGR :- SD 85050 00150					R.IRK U/S MOSTON BROOK												
150419861155	BBC		BAE	SSAT	6.2	7.61	9.8	79	3.5	.3	2.1	2.3	10	56	18	4	110	74	633		
150419861255	BBC		BAE	SSAT	6.2	7.66	9.8	79	2.8	.28	6.55	2	11.4	48	32	13		67	499		
150419861355	BBC		BAG	SSAT	6.5	7.65	9.6	78	2.35	.26	6.45	1.85	14.1	62	42	17		63	430		
150419861455	BBC		BAG	SSAT	6.7	7.63	9.7	79	2.25	.28	6.6	1.8	25	92	102	56	90	62	435		
150419861555	BBC		BCG	SSAT	7.5	7.58	9	75	2.3	.24	5.7	1.65	49	208	226	129		68	513		
150419861615	BBC		BCA	SSAT		7.46			2	.24	5.65	1.4	37	172	198	114		64	499		
SPT :- 0169801780				NGR :- SD 85100 00100					MOSTON BROOK UPSTREAM OF RIVER IRK												
150419861200	BBC		BAE	SSAT	6.2	7.58	9.7	79	2.4	.12	1.25	.05	25	76	53	20		55	654		
150419861300	BBC		BAE	SSAT	7	8.15	7.8	64	2.75	.12	.95	.5	85	240	160	79	175	41	528		
150419861400	BBC		BAE	SSAT	6.7	7.17	3.1	26	3.5	.28	.25	.85	441	1340	1158	512		38	429		
150419861500	BBC		BAA	SSAT	6.5	7.27	6.7	55	2.25	.1	.9	.4	141	476	602	320		24	315		
150419861600	BBC		BCA	SSAT	7	7.34	9	74	1.6	.1	1.05	.2	61	209	234	120	85	23	353		
SPT :- 0169801790				NGR :- SJ 84100 99200					RIVER IRK AT RED BANK ABOVE SCOTLAND WEIR												
150419861225	BAB		BAG	SXAT		7.37			3.5	.4	5.15	2	>24.5	244	113	61		67	649		2.41
150419861325	BBC		BAA	SSAT	6.5	7.48	8.5	69	2.85	.3	5.4	1.85	37	128	83	31		76	668		3.24
150419861326	BAB		BAG	SXAT		7.45			2.5	.48	4.7	1.65	>24.5	111	89	36		71	664		3.28
150419861425	BAB		BAG	SXAT		7.24			2.95	.3	3.4	1.45	>51	296	243	112	110	60	558		3.86
150419861525	BAB		BAG	SXAT		7.41			2.3	.32	4.8	1.7	>24.5	153	225	129		59	479		6.19
150419861625				SXAT		7.34			2.45	.3	4.55	1.6	>24.8	164	257	153		62	516		4.74
150419861725	BAB		BAG	SXAT		7.41			2.35	.28	4.45	1.3	44.9	145	233	134	90	58	494		3.9
150419861825	BAB		BAG	SXAT		7.4			3	.22	3.35	1.25	41.4	208	266	157		53	354		3.28
150419861925	BAB		BAG	SXAT		7.43			2.9	.2	2.85	1.1	24.9	132	179	107		49	466		2.86
150419862025	BAB		BAG	SXAT		7.44			3.05	.2	2.7	1	26	109	133	77	95	49	477		2.65
150419862125	BAB		BAG	SXAT		7.51			3.4	.22	3.1	1.05	20.9	80	93	52		53	505		2.54
150419862225	BAB		BAG	SXAT		7.52			4.15	.22	3.2	1.25	17.6	68	62	34		58	536		2.45
150419862325	BAB		BAG	SXAT		7.53			4.35	.24	3.2	1.3	15.8	59	44	23	110	60	539		2.39

END OF LISTING OF FILE :MASTER.ICL9NSPOOLLIB(21,*,1).DSLP2755009361040366(1) FOR USER :ARVTEWQ AT 1987/04/21__16:24:38

****

APPENDIX 3 (contd)

R.IRK CATCHMENT

MAP A